DOCUMENT RESUME

ED 053 596 FL 002 397

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TITLE Would an Orthography Based on Chomsky and Halle's Underlying Phonological Representations Be Optimal?
INSTITUTION Hawaii Univ., Honolulu. Dept. of Linguistics.
PUB DATE Mar 71
NOTE 18p.; In Working Papers in Linguistics, v3 n3 p1-18 Mar 1971

EDRS PRICE EDRS Price MF-$0.65 HC-$3.29
DESCRIPTORS *English, Linguistics, *Linguistic Theory, Orthographic Symbols, Phonetics, *Phonetic Transcription, Phonology, Reading, *Reading Processes, Semantics, *Spelling

ABSTRACT

Chomsky and Halle claim that an orthography based on their system of phonological representations of lexical items would be optimal. Their analysis assumes that (1) a reader need read only for meaning and not for sound, (2) an orthography based on their underlying phonological representations would not be exceptionally difficult to learn, and (3) there is no direct link between the phonetic aspect of a lexical item and its meaning. This paper argues that none of these assumptions is warranted and that an orthography based on a broad phonetic representation is to be preferred. (Author)

ED053596

Steinberg

From: Working Papers in Linguistics; Vol. 3, No. 3, March 1971.

WOULD AN ORTHOGRAPHY BASED ON CHOMSKY AND HALLE'S UNDERLYING PHONOLOGICAL REPRESENTATIONS BE OPTIMAL?[1]

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The investigations of Chomsky and Halle (1968) into the sound system of English have led them to posit a certain system of underlying phonological representations (hereafter, UPR) for lexical items. This system is of prime importance in these researchers' consideration of the problem of an optimal orthography for English. They hold that the process of reading will be facilitated to the extent that an orthography corresponds to the UPR rather than to the phonetic (overt phonological) representations (hereafter, OPR) of lexical items. (It is because our present English orthography closely approximates their UPR system that they conclude that our spelling system is a near optimal system for the lexical representation of English words (Chomsky and Halle, 1968: 49-50)). The rationale behind the view that an orthography based on UPR is more facilitating for reading than an orthography based on OPR is perhaps most clearly expressed by Carol Chomsky (1970) in what is essentially an elaboration of the Chomsky and Halle position. She states, "Consider also the common items of words such as courage/courageous, or anxi-ous/anxi-ety, or photograph/photograph-y/photograph-ic. Although the phonetic variations are considerable, they are perfectly automatic, and the lexical spellings ["lexical spelling" is used here in a non-orthographic

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sense to mean a specification of the UPR] can ignore them. They will be introduced by the phonological component. Of course, the conventional orthography ignores them as well. These are good examples of cases where the conventional orthography, by corresponding to lexical spelling rather than phonetic representation, permits immediate direct identification of the lexical item in question, without requiring the reader to abstract away from the phonetic details, and presents the lexical item directly, as it were." (pp. 291-92) Thus, because it is believed that a UPR based orthography would permit "immediate direct identification" of lexical items while an OPR based orthography would not since it would require the reader "to abstract away" phonetic details, it is held that an optimal orthography would be one that is based on UPR. The Chomsky and Halle position is succinctly expressed in their statement that "The fundamental principle of orthography is that phonetic variation is not indicated where it is predictable by general rule." (Chomsky and Halle, 1968: 49).[2]

While the account which Chomsky and Halle present regarding the optimality of an orthography based on their UPR analysis is interesting, it unfortunately rests on some very questionable assumptions even if one grants validity to their phonological rules and underlying phonological forms. Three such assumptions (assumptions also held by their supporters C. Chomsky (1970), Schane (1970) and O'Neil (1969)) are (1) a reader need read only for meaning and not for sound, (2) an orthography based on Chomsky and Halle's UPRs would not be exceptionally difficult to learn, and (3) there is no direct link between the phonetic aspect of a lexical item and its meaning. Before these assumptions may be considered, however, it will first be necessary to adumbrate the theoretical model which underlies Chomsky and Halle's analysis of the reading process.

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According to Chomsky, reading is a performance process which is the result of an interaction between the orthographic symbols which a person perceives and his language performance capability. This language performance capability itself involves a complex interaction between language competence (Chomsky's entire grammar) and factors which utilize and effect that competence. These factors, let us call them application factors, which interest with competence are: 1) governing rules for the use of competence, i.e., a set of heuristics or strategies which uses the rules of grammar for such performance goals as the producing and understanding of sentences,[3] 2) memory limitations, 3) distractions, 4) shifts of attention and interest, 5) errors, and 6) beliefs.[4] The input to the reading performance model may be an OPR or a UPR based orthography which symbolizes a lexical item. The output of such a model is the meaning of the lexical item.

In Chomsky and Halle's view, the phonetic representation is linked only indirectly to meaning. Phonological rules relate the phonetic representation to an underlying phonological form. It is this UPR which is directly linked with meaning. Since an OPR based orthography symbolizes the phonetic representation of a lexical item, such an orthography, it is thought, would require the reader to use phonological rules in order to determine the UPR. A reader must "abstract away from the phonetic details" as Carol Chomsky puts it. Thus, while an OPR based orthography would require that the governing use rules (application factor number 1) begin operations at the phonetic representation level of competence, presumably by "making use of the rules of phonological interpretation" (cf. fn. 3), a UPR based orthography would not. However, since it is thought that a UPR orthography provides an input directly to the underlying phonological level, and that the UPR of a lexical item is directly associated with meaning, it is concluded that the UPR orthography would not require the use of any of the rules of the phonological component.[5]

To illustrate Chomsky and Halle's position, let us consider the lexical item long. For that item Chomsky and Halle (1968: 211) assign the following derivation to the competence of the English speaker:

	+X	MEANING
	long	UNDERLYING PHONOLOGICAL REPRESENTATION
Rule 77b, in the context 79	lʌ̄ng	
Rule 78	lāng	
Diphthongization	lāwng	PHONOLOGICAL RULES
Rule 74	lāung	
Vowel Shift	lāong	
Rounding Adjustment	lɔ̄ʌng	
Nasal Assimilation	lɔ̄ʌŋ	PHONETIC REPRESENTATION

Thus, a UPR based orthography might write the lexical item in question as <long> (let the angled brackets indicate an orthographic representation) in order to provide a symbolization of the underlying phonological representation /long/, while an OPR based orthography might write that lexical item as <lɔ̄ʌŋ> so as to provide a symbolization of the phonetic representation [lɔ̄ʌŋ]. Since the phonological representation is postulated to be directly linked with meaning (+X) while the phonetic representation is not, Chomsky and Halle argue that a UPR based orthography will result in a more rapid discovery of meaning than will an OPR orthography.

With the above account of the Chomsky and Halle analysis of the reading process in mind, let us now consider some of the assumptions which underlie it.

Assumption 1. A reader need read only for meaning and not for sound. The essence of the basis for Chomsky and Halle's proposal for a UPR based orthography is that a reader need only recover the meaning of a lexical item. Because the phonetic aspect of a lexical item is not viewed as essential, Chomsky and Halle's version of an optimal orthography is one which avoids the phonetic level of representation but feeds directly to the underlying phonological representation of lexical items. If, however, it is desirable that a reader obtain phonetic information, the UPR based orthography of Chomsky and Halle might not be superior to one that was based on the OPR level instead.

Consider the sentences:

1) Every night, he flew a kite.

2) It is the sign, of someone divine.

Did you notice that night rhymes with kite and that sign rhymes with divine? If so, how would that fact be accounted for? According to Chomsky and Halle, the underlying phonological representations for these words would be /nixt/, /kīt/, /sign/, and /divīn/. When these UPRs are compared with their corresponding orthographic representations, <night> , <kite> , <sign> , and <divine> , it is found that there is a close approximation. For example, <gh> may be said to represent the postulated underlying /x/ in the word night, and <g> may be said to represent the underlying /g/ in the word sign. Such a close approximation does not obtain, however, between the orthographic representations and the OPRs of these words, since neither <gh> nor <g> correspond to any element in their phonetic representations. Thus, Chomsky and Halle would conclude that it is essentially the UPRs of the four words that our English spellings represent. But, if this is so, the question remains as to how a reader might detect a rhyme within the Chomsky and Halle framework, since no rhyme occurs for these words at the UPR level.

If we assume that the Chomsky and Halle analysis of UPRs and the reading process is correct, then, in order to detect rhyme, an orthography based on their UPRs would require that a reader abstract from the UPR to obtain the OPR. Because an OPR based orthography, in their view, would require a reader to abstract from the OPR to obtain the UPR, then it is evident that in either case of orthography, a certain amount of abstracting in which phonological rules would be utilized would be necessary. Thus, so long as a reader must read for sound (OPR) as well as meaning, there is no basis for the claim that an orthography based on Chomsky and Halle's underlying forms would be superior to one that is phonetically based.

Assumption 2. An orthography based on Chomsky and Halle's UPRs would not be exceptionally difficult to learn. If an orthography is to be considered as a candidate for optimality, it should be relatively easy to learn. Essentially, normal persons may learn an orthography by either of two methods of presentation. In the first, let us call it the orthography-object method, an orthographic form is presented in association with an object or event, e.g., the instructor presents <dog> on paper and points to an actual dog. In the second, let us call it the orthography-utterance method, an orthographic form is presented in association with a speech utterance, e.g., the instructor presents <dad> on paper and says [dæd].

The first of these methods, the orthography-object method, is one that is exceedingly time consuming, often impractical, and sometimes impossible. We don't always have objects and events, or pictures of objects or events at our disposal. Nor is it possible to present a direct representation for a variety of words in our vocabulary, e.g., to, with, the, a (prepositions, articles); pain, heat, wet (feelings); intelligence, theory, quality (abstracts). More importantly, reliance on this procedure would not stimulate

the learner to seek hypotheses which would attempt to relate the orthography to the sound system of the language (assuming that it is a sound based type of orthography that is being presented). The learner might simply associate the orthographic forms of lexical items with meaning, and never consider that such orthographic forms are comprised of symbols, each of which relates to some sort of sound system unit. Thus, the orthography may never be discovered to be a system, and the learner would be doomed to rote memorize every orthographic sequence of forms to its meaning. Because of problems such as these, the orthography-object method is not one that is highly valued.[6] On the other hand, the second method, that of orthography-utterance, is one that is highly valued. It requires only that an utterance be presented along with the orthographic form. With the phonetic representation of that utterance, the learner can determine a meaning, and thus learn to associate that meaning with the orthographic form in question.

Suppose that one wanted to teach an orthography based on Chomsky and Halle's UPRs. Because of the inadequacies and impracticality of the orthography-object presentation method, one would wish to use the orthography-utterance method. However, since with the orthography-utterance method something must be uttered, the question arises as to whether the instructor should pronounce the equivalents of the underlying phonological or the phonetic representations of lexical items. But if one did attempt to pronounce the equivalents of the UPRs, certain major difficulties would immediately be encountered. Firstly, a great many UPR equivalents would be difficult to pronounce since they would have segments which never occur in the phonetics of English. We do not, for example, have the sound ɔɛ in English (ɔɛ is a rounded æ), and yet ɔɛ is the vowel in the UPRs of such common words as boy, toy, and joy. Neither do we have the x in /nixt/ which occurs in the

UPRs of night, right, and light, nor the ng combination occurring at the end of words. Yet such combinations do occur in Chomsky and Halle's UPRs of long, song, and wrong. But even if an instructor were able to pronounce these UPRs somehow, how would a learner know that the weird utterance in which UPR /nixt/ is pronounced has to do with the word night and that the pronunciation of UPR /bɔɛ/ has to do with boy? Yet without establishment of such a connection, an orthography could never begin to be learned.

A second great difficulty relating to the pronunciation of UPRs is that many such forms would be misleading if uttered. For example, since the word mouse is given the underlying form /mūs/, when pronounced it would sound like the word moose. Other common lexical items which could mislead a learner are words like time, team, tame, whose underlying forms would be pronounced like the words team, tame, and tam, respectively. The incidence of misleading items would be very frequent since words with the vowels a^{I} (time), ī (team), and ē (tame) at the phonetic level are posited with vowels ī, ē, and æ, respectively, at the underlying phonological level.

A final difficulty with pronouncing UPRs, and one that is similar to the first difficulty, is that, while they would sound like English, so many words would come out like nonsense syllables. How would one learn that the pronunciation of UPR /re=duke/ relates to reduce, or that UPR /mūntən/ when pronounced is related to mountain? Clearly, because of difficulties such as these, an approach which would involve the pronunciation of UPRs is not a viable one. Therefore, if one wishes to teach a Chomsky and Halle UPR based orthography, it would be necessary to rely upon the pronunciation of the phonetic forms of lexical items.

If it is the OPRs rather than the UPRs of lexical items that must be pronounced, how easily might an orthography based on Chomsky and Halle's UPRs

be learned in accord with the orthography-utterance presentation method? Before an answer to this specific question may be attempted, certain aspects of the learning situation must be considered. Since according to the orthography-utterance presentation method a learner is presented with an orthographic form and a speech utterance, we may suppose that he would internalize a representation of each, i.e., he would internalize an orthographic representation and a phonetic representation. Thus, if the English word long is presented visually and auditorially, (1) the learner would see the orthographic form of that word and then internalize a representation of it, i.e., in the case of a UPR based orthography, the orthographic representation would be <long> while in the case of an OPR based orthography it would be <lɔŋ>, according to Chomsky and Halle's systems of UPRs and OPRs, and (2) the learner would hear the utterance and then internalize a representation of it, i.e., the phonetic representation [lɔŋ] would be internalized. The orthographic and phonetic representations therefore represent the visual and auditory stimuli which are presented to the learner.

After a learner obtains the orthographic and phonetic representations, what he must do is to match the sequence of elements of the orthographic representation with some target sequence of sound system elements so that it may be determined which sound element it is that each orthographic element symbolizes. The target sequence of sound elements would be the phonetic representation in the case of an OPR based orthography, and the UPR in the case of a UPR based orthography. Thus, in order to determine the value of each orthographic element, a person learning an OPR based orthography would be required to match the phonetic representation with the orthographic representation. A person learning the UPR based orthography, however, would be required to match the underlying phonological representation with the orthographic representation.

For an OPR based orthography where the target sequence of sound elements is the phonetic representation, the learner would encounter relatively little difficulty in making a match since both the orthographic and phonetic representations are obtained with the presentation of the visual and auditory stimuli. On the other hand, where, for Chomsky and Halle's UPR based orthography, the target sequence of sound system elements is the underlying phonological representation, some further activity on the part of the learner would be required in order to make a match. This is necessary because since a learner receives only the OPR of a lexical item when it is pronounced, he must (according to the Chomsky and Halle view) abstract away details from the phonetic form in order to arrive at the underlying phonological form. Only with the recovery of the UPR, presumably through the use of phonological rules, could the values of orthographic elements be determined. Clearly, then, an OPR based orthography would demand less effort of the learner than would a Chomsky and Halle UPR based orthography since an OPR based orthography would not require the extensive use of phonological rules in its acquisition.

Actually, besides the probability that a UPR based orthography would be less easy to learn, there is also the possibility that such an orthography may be completely unlearnable, at least not without special linguistic training. That it is the underlying phonological forms that must be matched to the orthographic representation is an hypothesis that may never occur to a learner. Since underlying phonological forms are posited by Chomsky and Halle to exist at a very abstract level,[7] the learner may never consider the possibility that UPRs are to be related to the orthography. While it might be hoped that the presentation of exercises which compare related forms, e.g., sane and sanity, will focus a learner's attention on the UPRs, one cannot be sure since the pronunciation of such forms inevitably involves their OPRs as well.

While the possibility remains that learners who are presented with a UPR based orthography may never realize that it is elements of UPRs which are to be associated with elements of the orthography, such is not likely to be the case with an OPR based orthography. One can prime, so to speak, the OPR level of a native speaker rather directly. For example, one may utter a word and then ask a subject to reproduce or identify sounds which he has heard. Suppose the tester utters the word time. Afterwards, the subject might be asked to utter the word sound which he heard, or he might be asked to decide whether the vowel sound he heard was [aɪ] or [i]. We would expect any normal speaker to be able to perform such tasks without difficulty. Furthermore, the learner of an OPR based orthography can even be told explicitly and can understand exactly what it is that he must learn. He could be told that different orthographic elements represent sounds that he hears. Examples could be given and explained without difficulty. However, to the learner of an abstract UPR based orthography, one could only say something to the effect that each orthographic element represents not an actual sound, but something that underlies the sound. Such a statement would, of course, be of little help to a learner since what it is that each orthographic element is to represent is not clear to him. Only special training in linguistics could make a learner aware of what it is that the orthography is to represent. Evidently, instruction is made easier with regard to the OPR based orthography because the OPR level is to some extent available to consciousness. In any case, it is clear from a consideration of the learning problem that an orthography based on Chomsky and Halle's underlying forms would be especially difficult, if not impossible, to learn. An orthography based on OPRs is certainly to be preferred.

Assumption 3. There is no direct line between the OPR of a lexical item and its meaning. While the arguments concerning the two previous assumptions challenged the optimality of the Chomsky and Halle UPR based orthography entirely from within the theoretical framework provided by these authors, the challenge to the present assumption involves a basic postulation that is a part of that framework. As will be shown, rejection of the Chomsky and Halle assumption that for the mature speaker there is no direct link between the OPR of a lexical item and its meaning has profound implications for the optimal orthography question.

When as children we learned the meanings of words, what we probably did was to associate what was said with a meaning, i.e., we directly linked a phonetic representation directly with a meaning. Now even though we may, through the course of time, have developed the phonological rules and underlying phonological representations which Chomsky and Halle have postulated, there is little reason to suppose, as these authors do, that we have lost, as a result, the original direct connection between the OPR of a lexical item and its meaning. From a standpoint of efficiency, it is more reasonable to assume that we continue to associate the meaning of a lexical item directly with its phonetic form. How uneconomical it would be if we had to involve, as Chomsky and Halle suggest, a variety of phonological rules and structures in such a determination. Considering the complexity which they claim is involved in determining the meaning of the relatively simple word long, it does not seem possible to account for the fantastic speed with which we can interpret and produce speech. A direct phonetic-meaning association, however, would reduce the amount of psychological work involved in relating meaning and sound. Thus, given that speakers learn such associations in their childhood, there is little basis for assuming that they should lose such valuable learning as they grow older.

It should be noted that adoption of the direct phonetic-meaning connection hypothesis does not necessarily entail the denial of the validity of the Chomsky and Halle phonological rules. Rules of the sort which they postulate are necessary to account for a variety of phenomena, particularly the creation and understanding of novel forms. But simply because we possess such rules is not reason enough to believe that they must be applied in every possible situation. A direct phonetic-meaning connection would eliminate the need to utilize phonological rules with regard to familiar forms.

But if, as seems likely, we do associate a phonetic representation and a meaning directly, what implications would this have for selecting an optimal orthography? Principally, an OPR based orthography would allow for direct identification of a meaning and would not require the reader to "abstract away from phonetic details." Lexical items written in an OPR based orthography would elicit both sound (OPR) and meaning without the mediation of extensive phonological rules. However, as was argued with respect to Assumption 1, such phonological rules would have to be used with the Chomsky and Halle UPR based orthography in order to detect rhyme. With regard to directness, and therefore, speed of identification, an OPR based orthography would be superior to one based on Chomsky and Halle's UPR system.

Conclusions. Since, as the discussion concerning Assumption 1 showed, a Chomsky and Halle based orthography would require as much abstracting as an OPR based one, and since, as the discussion concerning Assumption 2 showed, a Chomsky and Halle UPR based orthography would be much more difficult (if not impossible) to learn than would an OPR based one, and since, as the discussion concerning Assumption 3 showed, it is likely that an OPR based orthography would allow for virtually direct identification of both the sound

and meaning of lexical items, the Chomsky and Halle claim that an orthography based on their UPRs would be an optimal is one that is unwarranted. Rather, it seems more likely that an orthography based on the phonetic level of representation would make a better candidate for the optimality award. Such an orthography might be based on a broad rather than a narrow phonetic analysis such as that of Kenyon and Knott (1944).

The question of the validity of Chomsky and Halle's fundamental principle of orthography that phonetic variation is not indicated where it is predictable by general rule remains, however, an open one. If one grants, on the basis of the arguments presented in this paper, that an orthography based on their underlying forms would not be optimal, it may be that the principle of orthography is valid but that their UPR analysis is invalid. Since the Chomsky and Halle principle of orthography would be useful in reducing a narrow phonetic analysis to a broad phonetic analysis for the purpose of providing the basis for an orthography, such an hypothesis appears to be a viable one.

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FOOTNOTES

1. I would like to thank Robert Krohn for his helpful comments and stimulation.

2. While such a statement is succinct, it is somewhat vague since Chomsky and Halle do not, to my knowledge, offer a specification of what it is that makes a rule general or not.

3. As an example of how competence might be used in performance, Chomsky (1971) cites Katz and Postal (1964: 166) and their model of speech production. He says,

> "They outline a hypothetical procedure as follows: select a "message" which is a set of readings, i.e., semantic representations in the sense discussed above. Select a syntactic structure (in particular, what we have called the deep structure d in Σ) such that Σ maps onto S (the semantic representation) by the rules of semantic interpretation of the grammar. However this selection is accomplished, we may regard it as defining a mapping of S onto Σ, and in general, of semantic interpretations onto syntactic structures. Then, map Σ onto a speech signal, making use of the rules of phonological interpretation (giving the phonetic representation P) and rules that relate the latter to a signal." Katz and Postal suggest that a reverse sequencing would be involved in the understanding of sentences.

4. Item 1 is mentioned in Chomsky (1971), items 2 to 5 in Chomsky (1965), and item 6 in Chomsky (1967).

5. It should be emphasized that this account, in strict accordance with Chomsky's competence-performance distinction, regards the competence model (Chomsky's grammar) as a specification of the language knowledge which is utilized for performance by the governing rules in conjunction with other application factors. Competence is thus not considered as a performance process, but as a resource which is to be used in a performance process.

6. Such a method is, of course, a highly valued one for the deaf since this is a primary way they may learn language.

7. A less abstract phonological analysis is offered by Krohn (1969). He posits underlying forms closer to the phonetic level of representation. Similarly, Wang (1971) suggests major revisions of the Chomsky and Halle phonological system of English.

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